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Prevention of Accidental Poisoning Through Package and Label Design

KENNETH C. SCHNEIDER*

This article reports findings of a study which investigated the possibility of controlling accidental childhood poisoning by designing packages and labels to reduce children's attraction toward these products. The major conclusion of the article is that such an approach to poison control is feasible.

A large number of children are injured each year in the United States by a wide variety of consumer products. Many of these injuries result from children swallowing or inhaling potentially dangerous substances. Deeths and Breeden estimate that "two million poisonings and over four hundred deaths occur annually in the United States in children under five years of age" (1971, p. 299). Stracener and Scherz (1970) also relate the figure of two million accidental ingestions per year. Mofenson and Greensher (1970) using sample data from twenty-eight cities and 16,650 children, place the national rate closer to three million per year in the same age group.

Related statistics are equally startling. Approximately five percent of childhood ingestions reported in the National Clearinghouse for Poison Control Centers Bulletins (1970; 1971b; 1972b) between 1969 and 1971 required hospitalization. Although the number of childhood poisoning deaths steadily decreased throughout the 1960's, as late as 1969 over 240 children needlessly lost their lives by ingesting a variety of products (see Bulletin 1972a). Allowing even a generous margin of error in these estimates, the incidence and consequences of childhood poisoning in this country is staggering.

Of course, considerable effort is already being directed at this problem. Mass educational programs have long been used as a weapon against childhood poisoning, although many now doubt their effectiveness (Baltimore and Meyer 1969; Lowrey 1968; Scherz 1970; Sobel 1969; Suchman 1960). Federal regulations have had some impact, primarily through the Federal Hazardous Substances Labeling Act of 1960 and the Child Protection Act of 1966, though relatively few

products have been banned under these laws (Consumer Reports 1971). A growing network of local poison control centers and their umbrella organization, the National Clearinghouse for Poison Control Centers, have made some progress, particularly in the area of treatment and information dissemination. Finally, child resistant closures have aided, although they are far from the final, or only, preventive technique possible (Schneider 1975).

Most techniques to control childhood poisoning proposed or enacted to date share two characteristics. First, they all involve some sort of physical restraint which prevents the child from gaining access to the harmful substance, thereby thwarting the young child's natural inquisitiveness and tendency to explore the new and unknown. Second, none of the techniques has proven to be totally effective or without undesirable side effects. For example, several studies (Baltimore and Meyer 1969; Sobel 1969) indicate that educating families in poison prevention has little impact on the incidence of childhood poisoning. In addition, federal authorities have been reluctant to ban products, reserving such a drastic measure for only those substances which present a very serious safety hazard in terms of morbidity and mortality. Child resistant closures, in turn, are not designed to be one hundred percent effective (Bulletin 1972a). Also, it is not apparent that technologically more effective child resistant closures are warranted for either voluntary or regulated use. A 1970 committee report to the Food and Drug Administration (Bulletin 1971a, p. 2) expressed concern that "if the closure, although it resisted a large number of children's attempts to open it, were so difficult to open and to properly close that a number of adults would be unable to open it, the adults would either leave the closure open, or would place the contents in a container with a simpler closure." In spite of these many efforts, then, the problem of accidental childhood poisoning persists.

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TABLE 1
EXPERIMENTAL FACTORS AND LEVELS

Factors	Levels
Label written warning	Absent Small Large
Label pictorial warning	Absent Mr. Yuk Skull & Crossbones
Package color	White Black Red
Package shape	Round Triangular Square
Package fragrance	None Pleasant Antiseptic

There is another technique of poison prevention which has yet remained untried. Rather than physically restraining a child's ability to access a substance, it may be possible to reduce his or her attraction to the substance by appropriate design of packages and labels. For example, it may be that children are less attracted to some shapes than others. If so, it would be possible and desirable to utilize such "low attraction" shapes for containers of harmful substances.

Package and label design as a technique for poison prevention addresses the issue on a behavioral level. It assumes the task is one of behavior direction, with the package and label viewed as containing cues dictating certain responses on the part of the child. The objective is not to examine the child's understanding of the cues, but only his behavior on being confronted with them. Thus, it is conceptually a very different technique than any now in use. Certainly no one would propose that existing techniques (e.g., educational campaigns, child resistant closures) be replaced with package and label design. Rather, this new approach is proposed as a supplemental technique to those now utilized. In other words, manufacturers and public policy officials would not be faced with an either/or choice, but would have one more tool in their arsenal of defense against childhood poisoning.

This study represents an exploratory analysis of the ability of package and label characteristics to evoke differential levels of attraction on the part of young children. Very little, if any, research has been conducted on this topic to date. The goal of this study is to examine a variety of package and label characteristics and generate hypotheses about children's attraction toward products as a function of these characteristics. Given such hypotheses, it would be possible to design more conclusive research studies

to examine the effectiveness of package and label design as a technique to control accidental poisoning.

METHODOLOGY

Characteristics Examined

There are, of course, a very large number of package and label characteristics that can be examined in a study of this type. Three considerations were weighed in selecting particular package and label characteristics to include in the study. First, the selection of characteristics was guided by child development preference literature in order to include those most likely differentiable by young children. Second, consideration was given to both the willingness and ability of a manufacturer to manipulate a given characteristic for purposes of poison control. Third, consideration was given to the study design and general manageability.

After careful evaluation of these three considerations, it was decided to explore the effectiveness of two label and three package characteristics, each tested at three levels. These five characteristics and their associated levels are presented in Table 1.

Prior to conducting the study, it was necessary to create the packages or containers to be utilized. Several objectives, some conflicting, interacted to determine the final appearance of these containers. First, it was desired to create containers with a realistic appearance, yet not so familiar that a child might associate them with any particular household product currently available. Second, it was necessary to create containers sufficiently small to be feasibly transported between locations. Third, the containers needed to be both safe and durable, since each would be handled by several children. Fourth, due to budget limitations, it was desirable to economize on the cost of creating these containers.

Ideally, containers and labels could have been created by a professional agency. However, since this represented a prohibitively expensive strategy, they were created from materials readily available in the marketplace. Geometrically round containers were created from sixteen ounce, Red Owl brand, glass vinegar bottles. Geometrically triangular containers were created from twelve ounce, Pepto-Bismol brand, glass proprietary medicine bottles. Geometrically square containers were created from nine ounce, Yorkshire brand, glass relish bottles. Although differing in content volume, these container shapes were of nearly the same dimensions, likely a more salient attribute of size than is content volume, at least from the perspective of a young child. In addition, the three container shapes possessed equal neck sizes, and were all capped with identical white screw caps. Finally, the three container shapes possessed identically smooth textures.

Color was affixed to the containers with Deshler brand gloss red, gloss white, and gloss black all-surface enamel sprayed over a base of XIM brand primer. The base was applied to assure adherence of spray paint to the smooth glass surface. Deshler brand enamel was used as it is a nontoxic, nonlead based paint advertised as "suitable for children's furniture and toys."¹ Screw caps were not colored as all attempts to paint this surface failed.

Labels for the containers differed only with respect to size of written warning and type of pictorial warning. The labels were professionally printed utilizing a three-color process on gummed paper. A rectangular brick design was used in lieu of brand name or trademark. This strategy was followed so that no distinctive name or mark would appear as a constant on the label. The brick design, label border, and words "SHAKE WELL BEFORE SERVING" were printed in blue. Ingredient information and words "Made in USA—Schneider, Inc." were printed in yellow. Written warning, when present, was printed in black in the lower right corner of the label. Written warnings were added to the basic label using C-Thru brand dry transfer lettering. Finally, pictorial warning, when present, was printed in black immediately below the list of ingredients. The two pictorial warnings utilized were the traditional Skull and Crossbones sign and Mr. Yuk. Mr. Yuk is one of several new poison warnings which are being tested and introduced by local poison control centers. Others include Officer Ugg, a policeman with hands covering mouth, and NO-SIOP, a green, fanged snake (Taradejna 1975). Examples of the labels are presented in the figure.

Containers were impregnated with fragrance by soaking the screw cap in an appropriate liquid; this proved to be the most effective and practical of the several methods tested. The aroma was very distinct up to thirty minutes when the screw cap was soaked for approximately fifteen minutes. This was a considerably longer duration and stronger aroma than could be achieved through alternative strategies, including placing liquid directly on the container or spraying fragrance on the container. Schilling brand pure orange extract and Listerine brand mouthwash were used to effect, respectively, pleasant and anti-septic fragrances. Caps were placed on the containers with approximately the same pressure as one would apply after using a screw cap container in the home.

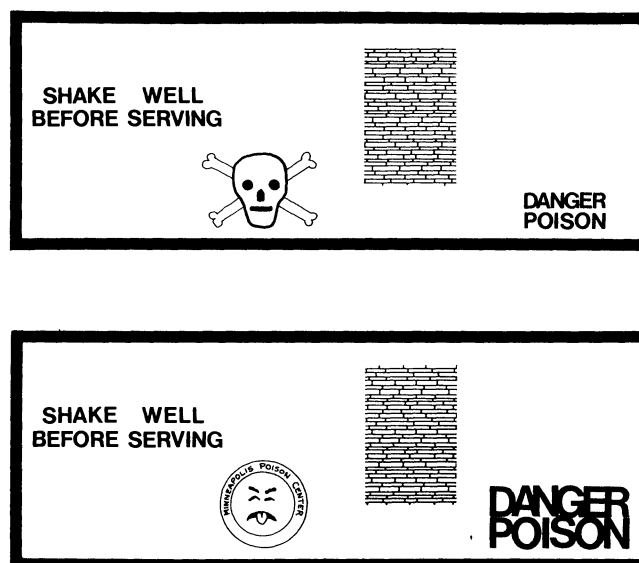
Subjects and Procedure

A total of eighty-one subjects in the forty-two to sixty-six month age category were used in the study. With eighty-one subjects it was possible to expose each level of each package or label characteristic to

¹ This information was provided on the Deshler package.

FIGURE

EXAMPLES OF LABELS UTILIZED IN THE STUDY^a



^a A total of nine different labels were needed, one for each combination of written and pictorial writing.

twenty-seven subjects. Individual containers represented a treatment composed of one level for each of the five characteristics. Containers (i.e., treatments) were assigned to subjects according to a one-third replication of a 3^5 factorial design (Cochran and Cox 1957, p. 291).

Subjects were selected from three nursery schools. One was a laboratory nursery school associated with the University of Minnesota Institute of Child Development. Subjects in this school were extremely heterogeneous by socioeconomic and racial background and were accustomed to involvement in research as part of their school activities. Hence they were generally "sophisticated" and cooperative. The study was conducted in an office located in a building adjoining each child's classroom.

The second school was a privately owned nursery school operated in the basement of a private residence in the Innsbruck area of Columbia Heights, a Minneapolis suburb. These students were primarily white children from middle to upper-middle class homes. Subjects in this school were less accustomed to research studies and treated the presence of a researcher as quite novel. Nevertheless, they were very friendly and cooperative regarding involvement in the study, which was conducted one floor above the school in a small, warmly decorated, and cheerful room of a private residence.

The third school was a church-affiliated nursery school and day-care center in St. Cloud, Minnesota, a city of 45,000 residents seventy miles north of Minneapolis. Students at this school were primarily

white children from upper-lower to middle class homes. Research was conducted very infrequently at this school. As a result, students at this nursery school were least receptive to the researcher and research process. The study was conducted in a small meeting room adjoining the student lunchroom.

Subject involvement in the study was strictly voluntary. Each potential subject was asked if he or she would like to go "play a game" with the researcher. The subject was encouraged to participate, though no force or pressure was applied to an unwilling or disinterested subject. Prior to approaching a subject, the researcher spent four to six class periods with the group and interacted several times with the subject. As a result, most subjects were at ease in the presence of the researcher. However, about twenty percent of the potential subjects were not willing to leave their room with the researcher.

Subjects were taken individually from their classroom for the study. Each subject was first read a story about three clowns who had eaten and drunk things which were "good for you" and "bad for you." (This story was part of an unsuccessful attempt to measure children's cognitions about harmful substances.) Upon completing the story, the researcher made an excuse to leave the room. At this point, each child was instructed to "sit here on this rug while I am gone. I will be back in a little while." No other instructions or comments were made. For all practical purposes, the subjects were under the assumption that this particular time period was a break in the "proceedings." They were given no indication as to what they were to do during this time. This procedure, then, created for the subject an environment of unsupervised, free-activity time; an environment in which the vast majority of accidental poisonings undoubtedly occur.

While alone, the child found several objects on the rug. Although most of these were usual play objects, one of the containers was also sitting on the rug. The container had been filled with eight ounces of fresh water. Concealed video tape equipment then recorded whatever behavior the child engaged in while alone with a container for a three minute period.

FINDINGS AND RESULTING HYPOTHESES

Impact of Individual Characteristics on Attraction

There are a number of different ways to define attraction, including visual contact behavior, manual contact behavior, smelling, and so forth. However, from the perspective of poison prevention it would seem that a very important qualitative difference in attraction occurs between children who open a container versus children who do not. If a child merely

looks at or touches a container there is relatively little danger of poisoning. However, once the container is opened, it is more likely that consumption will follow. Thus, low attraction was operationally defined as instances in which the subject did not open the container. Similarly, high attraction was defined as instances in which the subject did open the container. Based on this definition, 64 percent of the subjects (52 of 81) engaged in low attraction behavior, while the remaining 36 percent (29 of 81) engaged in high attraction behavior.

Label Written Warning. Of the five package and label characteristics examined, only one resulted in statistically significant ($p < .10$) different percentages of high attraction among the three levels, though statistical significance is perhaps a less important benchmark in exploratory research of this type. Of the subjects, 19, 48, and 41 percent exhibited high attraction toward containers with no written warning, small written warning, and large written warning, respectively. Subjects were significantly less attracted to containers bearing no written warning than to those bearing such a warning. Children in this study not only failed to recognize such a warning but were attracted to it.

This finding is extremely important as configurations beyond the "DANGER POISON" utilized in this study are considered. Noting the attraction generated by "DANGER POISON" and admitting the preliterate state of most children in the study, they were clearly not "reading" the configuration as it was intended to be read. It may be that subjects "read" whatever they wished to "read" upon seeing the configuration. If so, it would be logical to assume that the same attraction could have resulted from any set of words placed on the container. Attraction, it would seem, was more a function of the presence of a configuration of words rather than what that configuration might tell an adult. It would, therefore, seem extremely worthwhile to more fully explore the following hypothesis:

H1: Attraction is a function of the presence of written warnings and other verbiage contained on a label but not the size or content (what it says) of that verbiage.

Such configurations of words, of course, are one of the mainstays of package design. Verbiage is needed to provide suitable warnings to adults, provide directions for use and/or dosage, list ingredients, indicate guarantees, and so forth. Public regulations, for the most part, have contributed to the amount of verbiage placed on containers. If these findings concerning "DANGER POISON" hold true for other label information, the regulations may well have increased children's attraction toward hazardous substances. Perhaps a more even balance between

the need to inform adults and disinterest children should be sought.

What may be needed is not so much a reduction in amount and type of label information used for other purposes, but a reduction in the number of words used to convey this information. It may also be possible to reduce children's attraction by manipulating the type-face or style used to convey appropriate information, by making these comments less conspicuous or by grouping them together in one location on the label. It would, therefore, appear equally worthwhile to examine the hypothesis:

- H2:** Attraction is a function of the
- a. amount of label verbiage;
 - b. printing style used to convey information to adults;
 - c. extent to which verbiage blends with the label; and
 - d. location of verbiage on the label.

Label Pictorial Warning. No pictorial warning, Mr. Yuk, and the Skull and Crossbones resulted in 41, 37, and 30 percent high attraction, respectively. Though not statistically significant, there was a moderate tendency for pictorial warnings to reduce attraction. Of the two warnings examined, Skull and Crossbones showed a tendency to be somewhat more effective.

It is very interesting to note that, of the five characteristics tested, pictorial warning produced the smallest difference in percentage of high attraction from least effective to most effective level (41% – 30% = 11%). Pictorial warnings have long been a major tool of poison control in dealing with young children. Mr. Yuk, originally developed by Childrens' Hospital in Pittsburgh, represents the newest such warning. This approach to poison prevention does, of course, have a considerable amount of intuitive appeal. Unfortunately, it has a number of inherent problems, which help explain the weak results reported here. Skull and Crossbones, the traditional symbol, seems to have lost its original meaning, at least based on the number of subjects who, after completing a study similar to this one, made comments to the effect that packages containing the Skull and Crossbones contained "pirate food" (Schneider 1975). On the other hand, new symbols like Mr. Yuk must be taught to children. Mr. Yuk was not in common usage in Minnesota at the time of this study. As a result, many subjects were likely attracted by the novelty of the figure but unaware of its purpose.

Thus, based on the results of the exploratory study, preliminary as they must be, pictorial warnings may not be as effective as intuition would indicate, and certainly not as effective as other package and label characteristics. This, then, gives rise to the following hypothesis, with a relatively strong suspicion that it will be rejected upon detailed study:

- H3:** Pictorial warnings are the most effective technique to reduce attraction toward harmful substances.

Package Color. The remaining three characteristics examined pertained to the container itself rather than its label. Regarding package color, white containers led to the largest proportion of high attraction (48%), followed by black containers (33%), and finally, red containers (26%). The tendency was quite strong in the direction of high attraction toward white with relatively less attraction toward either black or red. This is a particularly disturbing, though quite understandable result because white is the color most often associated with household cleaning products (Sawyer 1974). The hypothesis generated from these findings, and one with rather important policy implications, is:

- H4:** Attraction is greater toward white containers than toward containers of other colors.

Package Shape. Both round and triangular shapes showed a tendency to be more effective than square containers. The percentages of high attraction were 30, 30, and 48 percent, respectively. The relevant hypothesis resulting from these data is quite obvious:

- H5:** Attraction is greater toward square containers than toward containers with other shapes.

Package Fragrance. The final characteristic examined was package fragrance. No fragrance, pleasant fragrance, and antiseptic fragrance resulted in 30, 33, and 44 percent high attraction, respectively. Again, these results are counterintuitive. Though one might have, *a priori*, expected an antiseptic fragrance to lead to less attraction, it actually resulted in the largest percentage of high attraction. Also, the mere presence of a fragrance, regardless of its aroma, resulted in relatively larger percentages of high attraction. Two important hypotheses can be derived from this finding:

- H6:** Attraction is greater toward containers which have a fragrance than toward containers which do not.
- H7:** Attraction is greater toward containers which have an antiseptic (or other unpleasant) fragrance than toward containers which have a pleasant fragrance.

Other Findings

A number of additional hypotheses arise upon examining selected pairwise combinations of package and/or label characteristics. These "interaction-like" effects may, in fact, help explain why larger differences in attraction were not found. It is possible that combinations of characteristics are more important in explaining attraction than separate characteristics considered separately.

TABLE 2
HIGH ATTRACTION PERCENTAGES FOR PICTORIAL
WARNING/FRAGRANCE COMBINATIONS^a

Pictorial warning	Fragrance		
<u>a. Complete pairwise combinations</u>			
	<u>None</u>	<u>Pleasant</u>	<u>Antiseptic</u>
None	56%	33%	33%
Mr. Yuk	22%	56%	33%
Skull & Crossbones	11%	11%	67%
<u>b. Summarized levels</u>			
	<u>Absence</u>	<u>Presence</u>	
Absence	56%	33%	
Presence	17%	42%	

^a Base for all cells is nine observations.

To illustrate, consider the percentages of high attraction resulting from pairwise combinations of pictorial warning and fragrance. These percentages are summarized in Table 2. There are two very plausible hypotheses which should be tested based on these results. First, it can be seen that combinations no pictorial warning/no fragrance, Mr. Yuk/pleasant fragrance, and Skull and Crossbones/antiseptic fragrance led to larger high attraction percentages than did other combinations of pictorial warning and fragrance. There may well be an interaction effect of some type between these two characteristics, resulting in the hypothesis:

H8: Label pictorial warning and package fragrance interact to produce an effect on attraction toward containers.

An even more important hypothesis can be derived from Table 2b. Absence of both pictorial warning and fragrance resulted in relatively large high attraction percentages (56%). Introducing either a pictorial warning or fragrance (but not both) onto the container caused attraction to decline (17% to 33%). However, when fragrance and pictorial warning appeared simultaneously, hesitation seemed to be overcome by curiosity and attraction increased (42%). Operationally, there appears to be a "curvilinear" effect regarding pictorial warning and fragrance, leading to the hypothesis:

H9: Containers with neither a pictorial warning nor fragrance, or with both characteristics produce greater attraction than containers with just one of these characteristics.

Generalizing a bit further, one can find support for the existence of a "clutter" effect relative to attraction

based on package and label design. One interpretation that can be given to the data in Table 2b is that attraction is not only a function of what is contained on a package but how much is contained. Of the five characteristics examined in this study, three have an absent/present property. These were label written warning, label pictorial warning, and package fragrance, all of which may or not be present on any given package. Of the eighty-one containers used in this study, twenty-one included just one (or none) of these three characteristics. Of these, six, or 29 percent resulted in high attraction. Thirty-six of the containers included two of the three characteristics, of which, twelve, or 33 percent resulted in high attraction. Finally, of the twenty-four containers with all three characteristics present, eleven, or 46 percent resulted in high attraction. The trend here is rather obvious; attraction increases as more things are placed on a container (i.e., the more "cluttered" a container becomes). Thus:

H10: There is a direct relation between attraction and the number of absent/present characteristics on a container.

The importance of this hypothesis cannot be overstated. The recent direction of childhood poisoning prevention has been to place control mechanisms (e.g., child resistant closures, pictorial warnings, written warnings, unpleasant fragrances) on the container. It may be that while relatively few of these absent/present factors provide control, too many stimulate curiosity. Perhaps industry and government ought not be so concerned with the number of controls utilized as with the effectiveness of a very few carefully selected and tested controls.

Table 3 presents evidence supporting the existence of a second "interaction-like" effect. This trend arose from pairwise combinations of package shape and fragrance. Though there is no intuitive explanation for this finding, pairwise combinations round shape/no fragrance, triangular shape/antiseptic fragrance, and square shape/either fragrance led to considerably greater percentages of high attraction (44% to 67%) than did other combinations of package shape and

TABLE 3
HIGH ATTRACTION PERCENTAGES FOR SHAPE/FRAGRANCE
COMBINATIONS^a

Package shape	Fragrance		
	None	Pleasant	Antiseptic
Round	44%	22%	22%
Triangular	22%	11%	56%
Square	22%	67%	56%

^a Base for all cells is nine observations.

fragrance (11% to 22%). The following hypothesis should then be investigated:

H11: Package shape and fragrance interact to produce an effect on attraction toward containers.

LIMITATIONS OF THE STUDY

Two problems related to subjects utilized in the study limit its generalizability to the population of all children in the forty-two to sixty-six month age range. Although not measured explicitly, the subjects represented a reasonable cross section of socio-economic backgrounds and, to a lesser extent, racial groups. In addition, preliminary analysis indicated that attraction was unrelated to both sex and age. However, the three nursery schools were selected on a convenience basis and may not have been totally representative of all types of nursery schools, or schools located in other areas. Also, nursery school children may not, in general, be totally representative of all children. As a result, the study is limited in terms of the process utilized in selecting subjects.

Another area of concern was the unwillingness of twenty percent of the potential subjects to participate in the study. This is a problem common to all research requiring voluntary cooperation. Nevertheless, it is especially bothersome in instances when small children are utilized as subjects. The children unwilling to cooperate were among the most shy and introverted students enrolled in the three schools. As a result, there is a strong possibility of subject personality bias in the study.

Two other conditions of the study should be considered. First, although every attempt was made to create a realistic environment, this was a laboratory study, and, as such, was subject to all the limitations of laboratory procedures. Future research efforts should make an effort to conduct the procedures in real-world environments, replicating as much as possible the unstructured, free activity time in which poisonings occur. Among other things, this should include in-home studies and periods of observation longer than three minutes.

Second, the extent to which findings related here were dependent upon the specific containers utilized is simply unknown. Analysis of such dependencies could, of course, be incorporated into future research. For example, it is important to know whether one can generalize from the orange fragrance utilized to all pleasant fragrances, or whether the Listerine fragrance utilized is perceived as similar to other antiseptic fragrances (e.g., alcohol, ammonia). Since all containers utilized were in the general category of bottles, issues such as these are also important with respect to package shape. For example, was the round bottle utilized seen by young children as similar

to round paint cans, round drug containers, and round floor wax bottles?

CONCLUSIONS AND FURTHER RECOMMENDATIONS

The results of this study, though certainly not conclusive, were strong enough to permit two general conclusions. The first conclusion is that package and label designs do have differential impact on children's attraction toward products. As such, it is possible to attack the problem of childhood poisoning from the perspective of package and label design. It is, therefore, strongly recommended that interested researchers subject the hypotheses outlined in this article to rigorous experimentation. This study has barely begun to scratch the surface of a very important problem area which deserves a considerable amount of attention.

An additional track for future research efforts would be to study the effect of other package and label characteristics. This study has demonstrated that package and label design can be effectively utilized to reduce attraction toward harmful substances. However, only five characteristics were tested. These, of course, do not represent the full range of characteristics that might be studied in a project of this type. Notably absent were characteristics of the product itself, among them, color and consistency (liquid, solid, etc.). Also absent were several additional package/label characteristics, including package texture (plastic, glass, etc.) and multicolored packages and labels.

The second conclusion is related to the extraordinarily large number of counterintuitive results. It is fairly obvious that policy cannot be set in this area on the basis of "gut" feelings, or expert opinions. It is, therefore, strongly recommended that industry and government undertake systematic research on the impact of package and label design or regulation on young children's attraction toward potentially harmful substances.

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